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(54) Title: THERAPEUTIC COMBINATIONS OF FATTY ACIDS

ESSENTIAL FATTY ACID (EFA) METABOLISM

n-6 series		n-3 series	
18:2n-6	LINOLEIC	ALPHA LINOLENIC	18:3n-3
	↓ Delta-6-desaturation	↓	
18:3n-6	GAMMA-LINOLENIC	STEARIDONIC	18:4n-3
	↓ Elongation	↓	
20:3n-61	DIHOMOGAMMALINOLENIC	EICOSA TETRAENOIC (n-3)	20:4n-3
	↓ Delta-5-desaturation	↓	
20:4n-6	ARACHIDONIC	EICOSAPENTAENOIC	20:5n-3
	↓ Elongation	↓	
22:4n-6	ADRENIC	DOCOSAPENT AENOIC (n-3)	22:5n-3
	↓ Delta-4-desaturation	↓	
22:5n-6	DOCOSAPENTAENOIC (n-6)	DOCOSAHEXAENOIC	22:6n-3

(57) Abstract: Eicosapentaenoic acid or any appropriate derivative (EPA) is disclosed in combination with arachidonic acid (AA) or an AA precursor, selected from DGLA and GLA, to give a pharmaceutical formulation.



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Therapeutic Combinations of Fatty Acids

There are two series of essential fatty acids (EFAs) in humans. They are termed "essential" because they cannot be synthesised de novo in mammals. Their metabolic pathways are shown in figure 1. These fatty acids can be interconverted within a series, but the omega-6 (n-6) series cannot be converted to the omega-3 series nor can the omega-3 (n-3) series be converted to the omega-6 series in humans. The main EFAs in the diet are linoleic acid of the omega-6 series and alpha-linolenic acid of the omega-3 series. However, to fulfil most of their biological effects these "parent" EFAs must be metabolised to the other fatty acids shown in figure 1. Each fatty acid probably has a specific role in the body. Particularly important in the n-6 series are dihomogammalinolenic acid (DGLA, 20:3n-6) and arachidonic acid (AA, 20:4n-6), while particularly important in the n-3 series are eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (22:6n-3). This patent specification particularly concerns combinations of AA and EPA.

AA is found as an important constituent of all cell membranes and particularly of cell membranes of nerve cells. It is an important component of many signal transduction systems which are activated by many different forms of cell stimulation. AA is usually found in cells in the form of phospholipids. Cell activation generates a range of active phospholipases which can release AA as the free acid. The free acid has many direct actions of its own in regulating protein kinases and other enzymes, in modulating movements of calcium and other ions, in activating receptors such as peroxisome proliferator activated receptors (PPARs), and in modulating gene function. Furthermore AA can be converted to an enormous

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range of even more active derivatives known by the general name of eicosanoids. These include prostaglandins, leukotrienes, thromboxanes, various types of hydroxy acids, lipoxins, hepoxilins and many other compounds. 5 These substances are often involved in inflammatory and thrombotic reactions and are frequently regarded as harmful in their overall effects. This harmful image is illustrated by the fact that intravenous AA is frequently lethal because of its thrombotic effects, and by the fact 10 that the steroids which are widely used, in particular for their anti-inflammatory effects, block the release of AA by phospholipases. Moreover, the class of drugs known as cyclo-oxygenase inhibitors, which include aspirin and many other well known compounds, known for their antithrombotic 15 and anti-inflammatory effects, inhibit the conversion of AA to prostaglandins and thromboxanes.

This concept of the potential toxicity of AA has become well established. The expert organisation in the field, the International Society for the Study of Fatty Acids and 20 Lipids (ISSFAL) in 1999 organised a workshop in association with the US National Institutes of Health. The remit of the workshop was to make recommendations concerning the human uses of EFAs. The participants, all leading experts in the field, had no doubts about the 25 harmful effects of AA, and emphasised this in their final statement (AP Simopoulos et al, Essentiality of and recommended dietary intakes for omega-6 and omega-3 fatty acids, Nutrition and Metabolism 1999; 43:127-130). The ISSFAL newsletter reporting on this workshop stated that 30 "after much discussion, consensus was reached on the importance of reducing the omega-6 polyunsaturated fatty acids (PUFAs) even as the omega-3 PUFAs are increased in the diet of adults and newborns for optimal brain and cardiovascular function. This is necessary to reduce

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adverse effects of arachidonic acid and its eicosanoid products".

In contrast to this general view of AA toxicity, the experts of ISSFAL and NIH were keen to promote the value of the n-3 EFAs, particularly EPA and DHA for human health. The view was taken that EPA and DHA would replace AA in cell membrane phospholipids and also reduce AA synthesis from linoleic acid. The lowering of AA levels by EPA and/or DHA was expected to have widespread beneficial effects on human health.

The present invention results from recent surprising observations of the inventor which suggest that this view may be wrong. Contrary to the general expert opinion, it has now been found that AA is highly desirable rather than undesirable and it may be helpful to administer AA in association with EPA. The present invention provides this combination treatment.

The present invention provides pharmaceutical formulations containing eicosapentaenoic acid or any appropriate derivative (hereinafter collectively referred to as EPA) and arachidonic acid (AA), as set out in the claims attached hereto. AA may be replaced by one or more of its precursors, DGLA or GLA. The ratio of EPA to AA is preferably between 1:1 and 20:1.

The EPA is preferably provided in a dose of between 100 mg and 10,000mg/day. The formulation may be a single preparation comprising 100-10,000 mg EPA. An alternative upper limit is 5,000 mg EPA. Preferably, the formulations of the invention comprise 1 - 4 g EPA and 0.1 - 2.0 g arachidonic acid (AA). Still preferred amounts are 1.5 - 3g EPA and 0.2 - 1g AA.

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The formulation may be a single daily dose preparation to give in one dose the above intakes, or may be in convenient divided doses, for example, a daily dose formed of four soft gelatin or other capsules, each containing
5 500 mg of EPA in an appropriate form and 150mg of AA in an appropriate form.

The compositions of the first aspect of the present invention are prepared by combining EPA in biologically assimilable form in which the EPA is at least 50% pure,
10 preferably at least 90% pure, and arachidonic acid (AA) in any biologically assimilable form. The starting materials must include one containing substantial amounts of the EPA. The same can apply for the AA, which may be at least 30% pure, preferably at least 90% pure.

15 Still preferably, the active ingredient of the formulations of the present invention consists essentially wholly of the EPA and AA or AA precursor. In that case, no significant amounts of other EFAs are present.

20 Flavourants or emulsifiers may be included to make the preparation palatable. Other conventional additives, diluents and excipients may be present. The preparation for ingestion may be in the form of a capsule, a dry powder, a tablet, an oil, an emulsion or any other appropriate form. The capsules may be hard or soft
25 gelatin capsules, agar capsules, or any other appropriate capsule.

The EPA is preferably composed of a triglyceride or ethyl ester which is 50% pure or purer, more preferably more than 90% pure. Other forms of the fatty acids which may
30 be useful include the free acids, salts, esters of any type, amides, mono-, di- or triglycerides, phospholipids or any other form which can lead to the incorporation of

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EPA into body tissues. If phospholipids are considered, it is specifically excluded from the present invention that a phospholipid containing two different fatty acids, that is containing both EPA and AA (or AA precursor) is
5 used. Phospholipids containing EPA may however be used in the present formulations when combined with phospholipids containing AA or AA precursor.

The formulations of the present invention may be used for the treatment of a wide range of diseases and disorders
10 including:

any psychiatric, neurological or other central or peripheral nervous system disease - in particular schizophrenia, depression, bipolar disorder and
degenerative disorders of the brain including Alzheimer's
15 disease and other dementias and Parkinson's disease;
asthma and other respiratory diseases;
diseases of the gastrointestinal tract including inflammatory bowel diseases and irritable bowel syndrome;
inflammatory disease affecting any system;
20 cardiovascular disease;
dyslipidaemia, any form of diabetes or any form of metabolic diseases;
dermatological diseases;
kidney or urinary tract diseases;
25 liver diseases;
disease of the male or female reproductive organs such as the breast or the prostate gland;
cancer or cancer cachexia;
diseases of the head and neck, including disease of
30 the mouth and teeth, of the eyes or of the ears;
infection with viruses, bacteria, fungi, protozoa or other organisms.

They may also be taken as a general nutritional supplement.

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The present invention further provides a method of treatment or prevention of any of the aforesaid diseases or conditions, in particular neurological and psychiatric disorders, especially schizophrenia, depression, bipolar disorder and degenerative disorders of the brain including Alzheimer's disease and other dementias and Parkinson's disease. The treatment or preventative method is, for example, by the combined application of EPA and AA at the dosage regime of between 100mg and 10,000mg/day EPA and a ratio of EPA to AA of between 1:1 and 20:1. A precursor to AA, selected from DGLA and GLA, may be used instead of AA. The preferred range of EPA to AA (or its precursor) is between 1:1 and 5:1.

The present invention still further provides a method of treatment or prevention of any disease selected from:

- asthma and other respiratory diseases;
- diseases of the gastrointestinal tract including inflammatory bowel diseases and irritable bowel syndrome;
- inflammatory disease affecting any system;
- cardiovascular disease;
- any form of dyslipidaemia, any form of diabetes or any form of metabolic diseases;
- any form of dermatological diseases;
- any form of kidney or urinary tract disease;
- any form of liver disease;
- any form of disease of the male or female reproductive system or related secondary sexual organs such as the breast or prostate gland;
- any form of cancer or for cancer cachexia;
- any disease of the head and neck including diseases of the mouth and teeth, of the eyes or of the ears; and
- any form of infection with viruses, bacteria, fungi, protozoa or other organisms

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by, for example, the combined application of EPA and AA at the dosage regime of between 100mg and 10,000mg/day EPA and a ratio of EPA to AA of between 1:1 and 20:1. A precursor to AA, DGLA or GLA, may be used instead of AA.
5 The preferred range of EPA to AA (or its precursor) is between 1:1 and 5:1.

Use of the formulations of the invention in the manufacture of a medicament for the treatment or prevention of any disease or disorder, including those
10 mentioned above, is included in the present invention.

The specific therapeutic compositions proposed are ones which provide not less than 100mg and not more than 10,000mg of EPA/day combined with AA, DGLA or GLA, in doses of between 100mg and 10,000mg/day. An alternative
15 upper limit is 5,000 mg/day of the fatty acids. Particularly preferred amounts are 1-4g per day EPA combined with 0.1 - 2.0 g per day arachidonic acid, or one of its precursors, GLA or DGLA. A still preferred composition comprises 1.5 - 3g EPA and 0.2 - 1g AA. The
20 present invention further provides a formulation, for example, in a one-a-day dose comprising 1.5 - 3 g EPA and 0.1 - 2.0 g arachidonic acid or one of its precursors.

The ratio of EPA to the omega-6 fatty acid is important because too much EPA is likely to lead to the loss of AA
25 from membranes, while too much AA may lead to adverse effects because of excessive conversion of AA to eicosanoid. The ratio of EPA to AA or DGLA or GLA should therefore never be less than 1:1, should preferably be in the range between 20:1 and 1:1, and should still
30 preferably be in the range of between 5:1 and 1:1. These combinations will ensure that the beneficial effects of EPA are enhanced and maintained even at relatively high EPA doses, because the provision of AA and its precursors

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will prevent AA depletion which may occur when too much EPA is given alone.

During absorption from the gut and within the body, EPA moieties are readily transformed intact from one chemical form to another. Simple esters such as ethyl or methyl esters are readily split by esterases and the freed fatty acids can then be bound by albumin or other binding or transport proteins or incorporated into complex lipids such as phospholipids, cholesterol ester or glycerides. The fatty acids in the present formulations can therefore be administered in any form such as glycerides, esters, free acids, salts, phospholipids, amides or any other form which leads to their incorporation into the blood and cell membranes.

The EPA, AA, DGLA or GLA may be derived from any appropriate source including plant seed oils, microbial oils from algae or fungal or marine oils from fish or other marine animals. They may be used in the form of the natural oil, if that oil meets the required purity requirements of the starting material, or may be purified to give products containing 30%, 40%, 50%, 60%, 70%, 80%, 90% or more of the fatty acid. A particularly useful form of EPA is the highly purified ethyl ester described in patent filings based on the preliminary UK filing 9901809.5. Synthetic routes to the fatty acids are also possible although at present are not economically feasible.

Once the oils containing the individual fatty acids have been obtained, and purified as necessary, the starting materials may be blended to give the desirable ratios of EPA to AA, DGLA or GLA described above.

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The blended fatty acid compositions may then be incorporated into any appropriate dosage form for oral, enteral, parenteral, rectal, vaginal, dermal or other route of administration. Soft or hard gelatin capsules, 5 flavoured oil blends, emulsifiers or other liquid forms, and microencapsulate powders or other dry form vehicles are all appropriate ways of administering the products.

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Example Formulations

- (a) Soft or hard gelatin capsules each containing 500mg or 1000mg of a mix of 10 parts 95% pure ethyl-EPA to 2 parts of 95% pure AA;
- 5 (b) As in (a) but where the AA and EPA ethyl esters are replaced with the fatty acids in any other appropriate bioassimilable form such as the free acid, tri-, di- or monoglyceride, other esters, salts such as the sodium, potassium or lithium salts,
- 10 amides, phospholipids or any other appropriate derivatives;
- (c) As in (a) or (b) but where the EPA or EPA derivative is 50%, 60%, 70%, 80% or 90% pure and where the AA or AA derivative is 30%, 40%, 50%, 60%, 70%, 80% or 90%
- 15 pure;
- (d) As in (a)-(c) but where the ratio of EPA to AA is anywhere in the range from 1:1 to 20:1;
- (e) As in (a)-(d) but where the material is in the form of a microencapsulated powder which can be used as a
- 20 powder or compressed into tablets. Such powders may be prepared by a variety of technologies known to those skilled in the art;
- (f) As in (a)-(d) but where the formulation is a liquid or emulsion, appropriately flavoured for palatable
- 25 oral administration;
- (g) As in (a)-(d) but where the material is formulated in to material appropriate for topical application such as a cream or ointment;

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(h) As in (a)-(g) but where the AA is replaced by one of its precursors, GLA or DGLA.

Brief description of the figures

Fig 1. the metabolic pathways of the two series of essential fatty acids.

Experimental Data

A trial was conducted of the administration of a placebo and three different doses of EPA, 1g, 2g and 4g/day in the treatment of schizophrenia in patients who were also taking the antischizophrenic drug clozapine. Previous pilot studies had suggested that EPA would have desirable effects and the expectation was that the higher the dose of EPA, the better would be the effect. 31 patents were entered into the study and followed for 12 weeks. They were assessed at baseline and 12 weeks using the Positive and Negative Symptom Scale for Schizophrenia (PANSS). The percentage improvements from baseline are shown in table 1. Placebo produced a small effect, 1g/day produced a larger effect, 2g/day produced a large effect of 26.0% compared to the usual 15-20% improvements on this scale generated by existing drugs for schizophrenia. It was expected that 4g/day would produce the best effect but this did not happen. The effect of 4g/day while there, was substantially less than the effect of 2g/day, and comparable to that of 1g/day.

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Table 1. Percentage improvements from baseline to 12 weeks on the Positive and Negative Symptom Scale for Schizophrenia (PANSS) in patients given placebo, 1g/day, 2g/day or 4g/day ethyl eicosapentaenoate

5

	<u>Placebo</u>	<u>1g</u>	<u>2g</u>	<u>4g</u>
n	7	9	9	6
Improvement	6.0%	18.3%	26.0%	16.3%

10 In these patients, and also in a further series of patients, the levels of DGLA, AA, EPA and DHA were measured in human red cells before starting treatment and after 12 weeks. The results were partly expected and partly surprising and are shown in table 2. As expected there was a dose-related rise in EPA which was greater the greater the dose. It was also expected that there would be a progressive decline in AA, the larger the EPA dose, the greater the fall in AA. However, this did not happen. 15 1g/day of EPA produced a small rise in AA while 2g/day produced a large rise. 4g/day EPA produced the expected fall in AA.

20 **Table 2.** Changes from baseline to 12 weeks in red cell concentrations (in $\mu\text{g/g}$) of eicosapentaenoic acid (EPA) and arachidonic acid (AA) in red blood cells in four groups of schizophrenic patients given placebo or 1g/d, 2g/d or 4g/d ethyl-EPA. + means a rise and - means a fall

25

	<u>Placebo</u>	<u>1g</u>	<u>2g</u>	<u>4g</u>
EPA	-0.6	+2.4	+33.7	+49.0
AA	-12.6	+2.7	+29.4	-26.5

30 It appeared that the improvement in schizophrenic symptoms was more related to the changes in AA than to the changes in EPA. This was tested in a larger series of patients where the improvement in PANSS was correlated with the

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changes in all the major EFAs. The values for r , the correlation coefficient, are shown in table 3 as is the statistical significance of the relationship. An r value of 1.0 means that the two parameters are perfectly related while one of 0.0 means that there is no relationship whatsoever.

Table 3. Correlations between the change from baseline to 12 weeks on the total PANSS score and the change from baseline to 12 weeks in the red cell concentration of various essential fatty acids. r , the correlation coefficient from a linear regression analysis, is shown. p is the statistical significance of the relationship.

<u>Fatty acid</u>	<u>Correlation</u> <u>coefficient r</u>	<u>Significance $p=$</u>
Dihomogammalinolenic (DGLA)	-0.51	0.09
Arachidonic (AA)	-0.81	0.001
Eicosapentaenoic (EPA)	-0.07	0.84
Docosapentaenoic (DPA)	-0.12	0.76
Docosahexaenoic (DHA)	-0.35	0.13

From the table it is clear that by far the strongest relationship is with AA, and the second strongest relationship is with DGLA. Rises in these two fatty acids are strongly associated with improvement in schizophrenic symptoms, as indicated by a fall in the PANSS score, hence the negative correlations. In contrast there is almost no relationship with EPA because high doses of EPA are associated with falls in red cell AA levels and the loss of clinical effect.

These results were completely unexpected. Far from EPA itself being the most desirable fatty acid in cell membranes it seems that AA and DGLA are more helpful. The likeliest interpretation of this is that AA is desirable

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when it is retained in membrane phospholipids and not converted to potentially dangerous eicosanoids. The effect of EPA may be to inhibit phospholipases and so keep AA in the phospholipid form. Very high doses of EPA, however, displace AA and the therapeutic effect is lost.

This interpretation was supported by a pilot study in which AA itself was given to five patients with schizophrenia. The expectation was that they would improve, but in fact their condition deteriorated. The administration of AA, without EPA to inhibit phospholipases, may lead to increased formation of eicosanoids rather than to incorporation of AA into phospholipids.

The conclusion to be drawn from these studies is that EPA is desirable, not in itself but because it raises the AA level in membrane phospholipids. High doses of EPA, far from being valuable in themselves, may be undesirable because they lead to excessive loss of AA from membranes. The way to get around this issue, and to boost the clearly desirable effects of EPA, is to keep to relatively low doses of EPA, but also to boost the level of AA by administering the EPA with either AA or one of its precursors, DGLA or gamma-linolenic acid GLA. When AA in a dose of 1g/day was given to two patients who had already been taking 2g/day EPA for 3 months, they experienced a substantial further improvement without any of the worsening seen when AA was given alone.

US Patent 4,977,187 provided for combinations of n-3 fatty acids and n-6 fatty acids and vitamin E in the treatment of schizophrenia. However, that patent did not direct attention to AA specifically or to EPA specifically, or to the specific combination of EPA with AA or its immediate precursors or to the specific doses and ratios of EPA and

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AA described in this specification. Any n-6 fatty acid could be combined with any n-3 fatty acid in any ratio in US 4,977,198 and corresponding patents.

5 A review of the literature suggests that the phenomenon described here is not only true of schizophrenia but of several disorders where EPA is therapeutically useful. There are many studies describing the value of low doses of EPA containing products in cardiovascular diseases, in inflammatory disease and in other disorders. However,
10 when investigators have gone to higher doses, these desirable therapeutic effects have been lost. To take two examples, high doses of EPA completely failed to exert beneficial effects in patients undergoing angioplasty for coronary vascular disease, or in patients with
15 inflammatory bowel disease, even though earlier studies with smaller EPA doses had given strong evidence of benefit. The authors had no real explanation for the trial failure and did not consider the possibility that excess depletion of AA may have been the cause.

20 The use of the formulations of the present invention could be very wide-ranging.

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Claims

1. Pharmaceutical formulations, prepared by combining:
eicosapentaenoic acid or any appropriate
derivative (EPA), in any biologically assimilable
5 form in which the EPA is at least 50% pure; and
arachidonic acid (AA) in any biologically
assimilable form.
2. Pharmaceutical formulations according to claim 1, in
which the EPA is at least 90% pure.
- 10 3. Pharmaceutical formulations according to claim 1 or
2, in which the AA is at least 30% pure.
4. Pharmaceutical formulations according to claim 3, in
which the AA is at least 90% pure.
5. Pharmaceutical formulations according to any
15 preceding claim in which the ratio of EPA to AA is
between 1:1 and 20:1.
6. Pharmaceutical formulations according to any
preceding claim in which the EPA is provided in a
dose of between 100 mg and 10,000mg/day.
- 20 7. Pharmaceutical formulations according to any
preceding claim containing 1 - 4 g EPA and
0.1 - 2.0 g arachidonic acid (AA).
8. Pharmaceutical formulations containing
1.5 - 3 g eicosapentaenoic acid or any
25 appropriate derivative (EPA), in any biologically
assimilable form; and
0.1 - 2.0 g arachidonic acid (AA) in any
biologically assimilable form.

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9. Pharmaceutical formulations according to any preceding claim in which the active ingredient consists essentially wholly of the EPA and AA.
- 5 10. Formulations according to any preceding claim in which the AA is replaced by its precursor DGLA.
11. Formulations according to any preceding claim in which the AA is replaced by its precursor GLA.
- 10 12. Pharmaceutical formulations comprising EPA and an AA precursor, selected from DGLA and GLA, in which the EPA is provided in a dose of between 100mg and 10,000mg/day and in which the ratio of EPA to AA precursor is between 1:1 and 20:1.
13. Formulations according to any preceding claim further comprising a flavourant or emulsifier.
- 15 14. Formulations according to any preceding claim in which the EPA is composed of a triglyceride or ethyl ester which is 50% pure or purer, preferably more than 90% pure.
- 20 15. Formulations according to any preceding claim for the treatment of any psychiatric, neurological or other central or peripheral nervous system disease, in particular schizophrenia, depression, bipolar disorder and degenerative disorders of the brain including Alzheimer's disease and other dementias and 25 Parkinson's disease.
16. Formulations according any of claims 1-14 for use in the treatment of any disease selected from:
asthma and other respiratory diseases;

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diseases of the gastrointestinal tract
including inflammatory bowel diseases and irritable
bowel syndrome;

- 5 inflammatory disease affecting any system;
 cardiovascular disease;
 any form of dyslipidaemia, any form of diabetes
or any form of metabolic diseases;
 any form of dermatological diseases;
 any form of kidney or urinary tract disease;
10 any form of liver disease;
 any form of disease of the male or female
reproductive system or related secondary sexual
organs such as the breast or prostate gland;
 any form of cancer or for cancer cachexia;
15 any disease of the head and neck including
diseases of the mouth and teeth, of the eyes or of
the ears; and
 any form of infection with viruses, bacteria,
fungi, protozoa or other organisms.
- 20 17. A method of treatment or prevention of any
 psychiatric, neurological or other central or
 peripheral nervous system disease, in particular
 schizophrenia, depression, bipolar disorder and
 degenerative disorders of the brain including
25 Alzheimer's disease and other dementias and
 Parkinson's disease, by the application of a
 formulation according to any of claims 1-14.
18. A method of treatment or prevention of any disease
 selected from:
30 asthma and other respiratory diseases;

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diseases of the gastrointestinal tract
including inflammatory bowel diseases and irritable
bowel syndrome;

inflammatory disease affecting any system;

5 cardiovascular disease;

any form of dyslipidaemia, any form of diabetes
or any form of metabolic diseases;

any form of dermatological diseases;

any form of kidney or urinary tract disease;

10 any form of liver disease;

any form of disease of the male or female
reproductive system or related secondary sexual
organs such as the breast or prostate gland;
any form of cancer or for cancer cachexia;

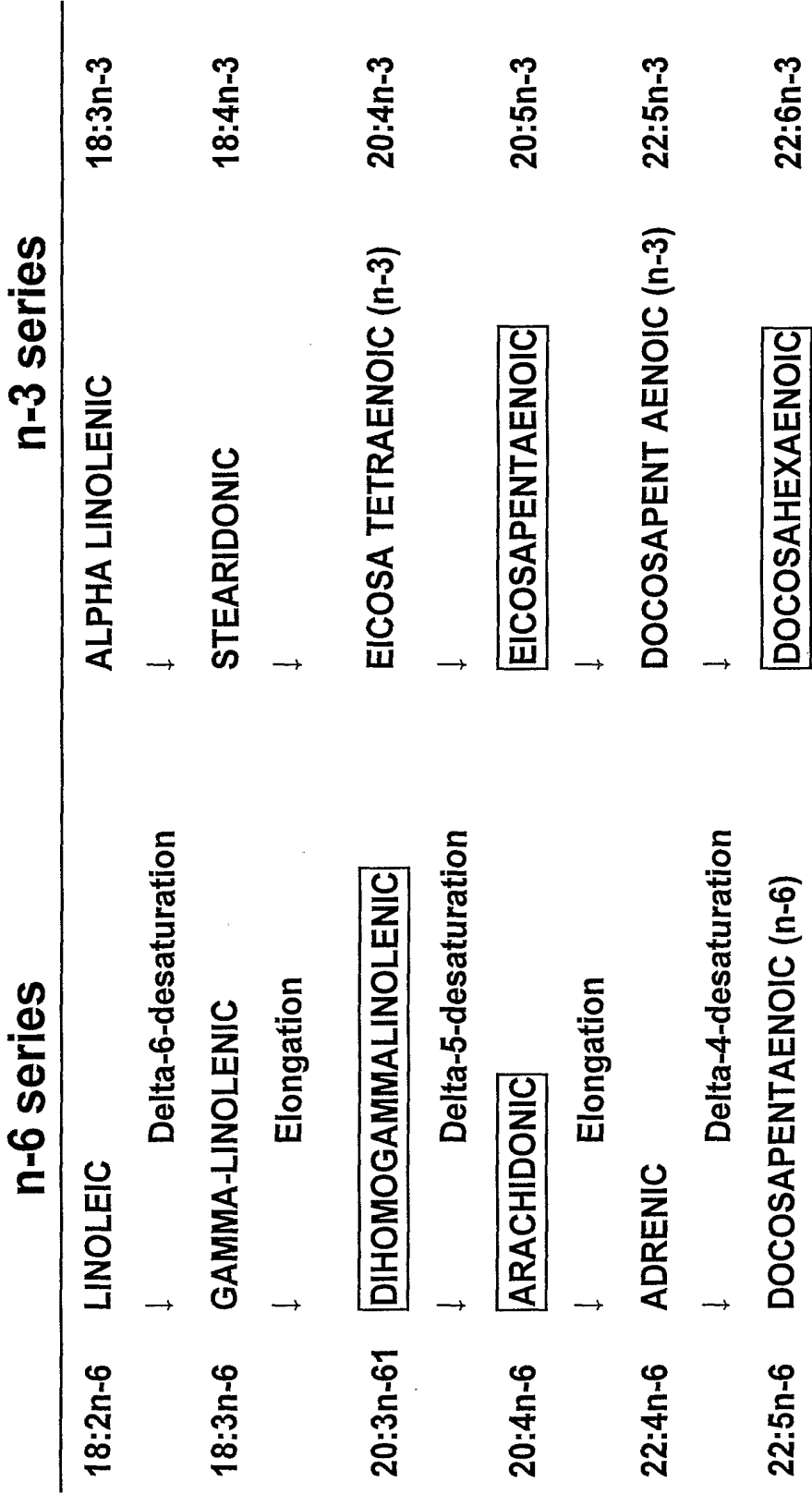
15 any disease of the head and neck including
diseases of the mouth and teeth, of the eyes or of
the ears; and

any form of infection with viruses, bacteria,
fungi, protozoa or other organisms

20 by the application of a formulation according to any
of claims 1-14.

Fig. 1

ESSENTIAL FATTY ACID (EFA) METABOLISM



INTERNATIONAL SEARCH REPORT

Internat	Application No
PCT/GB	01/02717

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 A61K31/202 A61P25/18 //(A61K31/202,A61K31:202)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ, EMBASE, BIOSIS, CHEM ABS Data, MEDLINE, SCISEARCH

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 516 800 A (HORROBIN DAVID F) 14 May 1996 (1996-05-14) column 3, line 10 - line 21; example 3 ----	1-18
X	US 4 977 187 A (HORROBIN DAVID F) 11 December 1990 (1990-12-11) examples 2,5,7 ----	1-18
X	US 5 198 468 A (HORROBIN DAVID F) 30 March 1993 (1993-03-30) column 3, line 16 - line 25; examples 2,3 ----	1-18
X	EP 0 711 503 A (SCOTIA HOLDINGS PLC) 15 May 1996 (1996-05-15) page 3, line 31 - line 39; example 3 ----- -/--	1-18

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

29 October 2001

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

 Interna I Application No
 PCT/GB 01/02717

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 713 653 A (SCOTIA HOLDINGS PLC) 29 May 1996 (1996-05-29) page 3, line 26 - line 34; example 3 ---	1-18
X	US 4 526 902 A (RUBIN DAVID) 2 July 1985 (1985-07-02) column 2, line 43 - line 60 ---	1-18
X	US 5 516 801 A (HORROBIN DAVID F ET AL) 14 May 1996 (1996-05-14) column 3, line 26 - line 35; example 4 ---	1-18
X	US 5 583 159 A (HORROBIN DAVID F ET AL) 10 December 1996 (1996-12-10) abstract; examples 11-20 ---	1-16,18
X	US 5 378 732 A (HORROBIN DAVID F ET AL) 3 January 1995 (1995-01-03) example abstract ---	1-16,18
X	US 5 252 333 A (HORROBIN DAVID F) 12 October 1993 (1993-10-12) column 4, line 21 - line 38; examples 2,4,5,7,9,10,12-14,27,28 ---	1-18
X	WO 99 33355 A (SAWATZKI GUENTHER ; FARWER SANDRA (DE); KLIEM MICHAEL (DE); BOEHM G) 8 July 1999 (1999-07-08) abstract; table 2 ---	1-16,18
X	US 5 260 067 A (ZHENG XU) 9 November 1993 (1993-11-09) column 15, line 56 - line 67; examples 1,6,7 ---	1-16,18
X	DATABASE WPI Section Ch, Week 199932 Derwent Publications Ltd., London, GB; Class B05, AN 1999-371708 XP002181361 & CN 1 212 867 A (SONG F), 7 April 1999 (1999-04-07) abstract ---	1-16,18
X	DATABASE WPI Section Ch, Week 199443 Derwent Publications Ltd., London, GB; Class B05, AN 1994-347054 XP002181362 & JP 06 271464 A (TOKIWA YAKUHI KOGYO KK) , 27 September 1994 (1994-09-27) abstract ---	1-16,18

	---/---	

INTERNATIONAL SEARCH REPORT

Internat Application No
PCT/GB 01/02717

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE WPI Section Ch, Week 199330 Derwent Publications Ltd., London, GB; Class B05, AN 1993-239917 XP002181364 & JP 05 163142 A (TOKIWA YAKUHHN KOGYO KK) , 29 June 1993 (1993-06-29) abstract</p> <p>----</p>	1-16,18
X	<p>DATABASE WPI Section Ch, Week 199231 Derwent Publications Ltd., London, GB; Class B05, AN 1992-253493 XP002181363 & JP 04 169524 A (NISSEI MARINE KOGYO KK), 17 June 1992 (1992-06-17) abstract</p> <p>----</p>	1-16,18
X	<p>PATENT ABSTRACTS OF JAPAN vol. 009, no. 287 (C-314), 14 November 1985 (1985-11-14) & JP 60 132916 A (NISSHN SEIYU KK), 16 July 1985 (1985-07-16) abstract</p> <p>-----</p>	1-16,18

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: 1-16 part

The initial phase of the search revealed a very large number of documents relevant to the issue of novelty. So many documents were, in fact, retrieved that it is impossible to determine which parts of the claims may be said to define subject-matter for which protection might legitimately be sought (Article 6 PCT). For these reasons, a meaningful search over the whole breadth of the claims was impossible. Consequently, the search was restricted towards (i) the methods defined in Claim 17 and 18 and (ii) the pharmaceutical formulations defined in Claims 1 to 16 IN SO FAR as these pharmaceutical formulations have previously been used in a method as defined in Claim 17 and 18. The Applicant is warned however, that further searching may be necessary, if and when the scope of the claims is restricted.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

 Internat Application No
 PCT/GB 01/02717

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5516800	A	14-05-1996	AT 144706 T	15-11-1996
			AU 666782 B2	22-02-1996
			AU 5183093 A	09-06-1994
			AU 5232996 A	18-07-1996
			CA 2109777 A1	27-05-1994
			CN 1104494 A	05-07-1995
			DE 69305723 D1	05-12-1996
			DE 69305723 T2	03-04-1997
			DK 599576 T3	25-11-1996
			EP 0599576 A1	01-06-1994
			EP 0733360 A2	25-09-1996
			ES 2093935 T3	01-01-1997
			GR 3021692 T3	28-02-1997
			HK 114297 A	29-08-1997
			JP 6199663 A	19-07-1994
			NO 934266 A	27-05-1994
			NZ 250265 A	24-06-1997
			RU 2123844 C1	27-12-1998
			SG 47838 A1	17-04-1998
			ZA 9308835 A	02-08-1994
US 4977187	A	11-12-1990	AT 87825 T	15-04-1993
			AU 618814 B2	09-01-1992
			AU 3597489 A	14-12-1989
			AU 633442 B2	28-01-1993
			AU 7943491 A	12-09-1991
			CA 1334004 A1	17-01-1995
			DE 68905863 D1	13-05-1993
			DE 68905863 T2	26-08-1993
			EP 0347056 A1	20-12-1989
			EP 0454102 A2	30-10-1991
			ES 2053990 T3	01-08-1994
			IE 63303 B	05-04-1995
			JP 2032017 A	01-02-1990
			JP 2796838 B2	10-09-1998
			KR 129666 B1	09-04-1998
			NZ 229423 A	28-10-1992
			NZ 239126 A	27-07-1997
			US 5120760 A	09-06-1992
			ZA 8904380 A	28-02-1990
US 5198468	A	30-03-1993	AT 81453 T	15-10-1992
			AU 608012 B2	21-03-1991
			AU 1821888 A	05-01-1989
			CA 1310911 A1	01-12-1992
			DE 3875286 D1	19-11-1992
			DE 3875286 T2	11-03-1993
			EP 0296751 A1	28-12-1988
			ES 2045120 T3	16-01-1994
			GR 3006403 T3	21-06-1993
			HK 158496 A	30-08-1996
			IE 63386 B	19-04-1995
			JP 1022819 A	25-01-1989
			JP 2070571 C	10-07-1996
			JP 7088301 B	27-09-1995
			KR 9610832 B1	09-08-1996
			ZA 8804484 A	29-03-1989

INTERNATIONAL SEARCH REPORT

Internat Application No

PCT/GB 01/02717

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0711503	A	15-05-1996	AU 3782895 A	23-05-1996
			CA 2162739 A1	15-05-1996
			CN 1135841 A	20-11-1996
			EP 0711503 A2	15-05-1996
			FI 955449 A	15-05-1996
			JP 8205769 A	13-08-1996
			NO 954573 A	15-05-1996
			NZ 280457 A	24-11-1997
			SG 33588 A1	18-10-1996
			ZA 9509683 A	29-05-1996
EP 0713653	A	29-05-1996	AU 3786995 A	30-05-1996
			CA 2163466 A1	24-05-1996
			CN 1132607 A	09-10-1996
			EP 0713653 A1	29-05-1996
			FI 955618 A	24-05-1996
			JP 8205832 A	13-08-1996
			NO 954726 A	24-05-1996
			NZ 280468 A	26-08-1998
			SG 35039 A1	01-02-1997
			ZA 9509843 A	29-05-1996
US 4526902	A	02-07-1985	CA 1239587 A1	26-07-1988
			CH 661209 A5	15-07-1987
			DE 3438630 A1	02-05-1985
			FR 2553662 A1	26-04-1985
			GB 2148713 A , B	05-06-1985
			IT 1178170 B	09-09-1987
			JP 60115522 A	22-06-1985
			SE 462701 B	20-08-1990
			SE 8405308 A	25-04-1985
US 5516801	A	14-05-1996	AT 159856 T	15-11-1997
			AU 666747 B2	22-02-1996
			AU 4466693 A	24-02-1994
			CA 2104567 A1	22-02-1994
			CN 1091285 A , B	31-08-1994
			DE 69315020 D1	11-12-1997
			DE 69315020 T2	16-04-1998
			DK 585026 T3	02-06-1998
			EP 0585026 A1	02-03-1994
			ES 2110060 T3	01-02-1998
			GR 3025898 T3	30-04-1998
			HK 1000997 A1	15-05-1998
			JP 6157303 A	03-06-1994
			NO 932983 A	22-02-1994
			NZ 248422 A	24-06-1997
			RU 2122409 C1	27-11-1998
			US 5618558 A	08-04-1997
			ZA 9305976 A	14-03-1994
			AT 164518 T	15-04-1998
			AU 666748 B2	22-02-1996
			AU 4474893 A	24-02-1994
			CA 2104566 A1	22-02-1994
			CN 1090490 A	10-08-1994
			DE 69317716 D1	07-05-1998
			DE 69317716 T2	17-09-1998
			DK 585027 T3	11-05-1998

INTERNATIONAL SEARCH REPORT

 Internal application No
 PCT/GB 01/02717

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5516801 A		EP 0585027 A1	02-03-1994
		ES 2117104 T3	01-08-1998
		GR 3026708 T3	31-07-1998
		JP 6172169 A	21-06-1994
		NO 932984 A	22-02-1994
		NZ 248451 A	27-07-1997
		RU 2122408 C1	27-11-1998
		US 5888541 A	30-03-1999
		ZA 9306133 A	17-03-1994
US 5583159 A	10-12-1996	US 5663202 A	02-09-1997
		AU 673868 B2	28-11-1996
		AU 5395894 A	04-08-1994
		CA 2114047 A1	27-07-1994
		CN 1104496 A	05-07-1995
		EP 0609064 A1	03-08-1994
		JP 6279277 A	04-10-1994
		NO 940266 A	27-07-1994
		NZ 250757 A	24-06-1997
		ZA 9400392 A	01-09-1994
US 5378732 A	03-01-1995	AT 133334 T	15-02-1996
		AU 680725 B2	07-08-1997
		AU 1656395 A	29-06-1995
		AU 657009 B2	23-02-1995
		AU 2968792 A	03-06-1993
		CA 2084273 A1	03-06-1993
		DE 69207885 D1	07-03-1996
		DE 69207885 T2	25-07-1996
		DK 551729 T3	12-02-1996
		EP 0551729 A1	21-07-1993
		EP 0676197 A2	11-10-1995
		ES 2082390 T3	16-03-1996
		GR 3019270 T3	30-06-1996
		HK 131096 A	26-07-1996
		JP 5286854 A	02-11-1993
		NO 303047 B1	25-05-1998
		NZ 245343 A	24-06-1997
		US 5859055 A	12-01-1999
		ZA 9209316 A	09-09-1993
US 5252333 A	12-10-1993	US 5422115 A	06-06-1995
		AT 65182 T	15-08-1991
		AU 618730 B2	09-01-1992
		AU 1536188 A	27-10-1988
		CA 1306944 A1	01-09-1992
		DE 3863678 D1	22-08-1991
		DK 225588 A	28-10-1988
		EP 0289204 A2	02-11-1988
		ES 2040847 T3	16-07-1996
		GR 3002426 T3	30-12-1992
		HK 127793 A	26-11-1993
		IE 60568 B	27-07-1994
		JP 1013021 A	17-01-1989
		JP 2699083 B2	19-01-1998
		KR 9613433 B1	05-10-1996
		NZ 224380 A	25-06-1991
		SG 113593 G	21-01-1994

INTERNATIONAL SEARCH REPORT

 Internat Application No
 PCT/GB 01/02717

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5252333	A		ZA 8802947 A	22-02-1989
			AT 96327 T	15-11-1993
			AU 2147988 A	02-03-1989
			CA 1332358 A1	11-10-1994
			DE 3885212 D1	02-12-1993
			DE 3885212 T2	07-04-1994
			DK 469488 A	26-02-1989
			EP 0305097 A2	01-03-1989
			EP 0432700 A2	19-06-1991
			IE 61750 B	30-11-1994
			JP 1083021 A	28-03-1989
			KR 9700043 B1	04-01-1997
			NZ 225909 A	28-04-1992
			ZA 8806322 A	30-05-1989
WO 9933355	A	08-07-1999	DE 19757414 A1	01-07-1999
			AU 2416299 A	19-07-1999
			BR 9814467 A	10-10-2000
			CN 1282223 T	31-01-2001
			WO 9933355 A2	08-07-1999
			EP 1041896 A2	11-10-2000
			NO 20003265 A	22-06-2000
US 5260067	A	09-11-1993	CN 1042658 A	06-06-1990
			DE 68927163 D1	17-10-1996
			DE 68927163 T2	03-04-1997
			EP 0381823 A2	16-08-1990
			JP 2262514 A	25-10-1990
CN 1212867	A	07-04-1999	NONE	
JP 6271464	A	27-09-1994	NONE	
JP 5163142	A	29-06-1993	NONE	
JP 4169524	A	17-06-1992	NONE	
JP 60132916	A	16-07-1985	NONE	